

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G01N 33/53, 33/50, C12Q 1/00, G01N 35/02		A1	(11) International Publication Number: WO 96/30761 (43) International Publication Date: 3 October 1996 (03.10.96)
(21) International Application Number: PCT/US96/01092 (22) International Filing Date: 26 January 1996 (26.01.96) (30) Priority Data: 08/411,130 27 March 1995 (27.03.95) US (71) Applicant: WARNER-LAMBERT COMPANY [US/US]; 201 Tabor Road, Morris Plains, NJ 07950 (US). (72) Inventors: BECKER, Katherine; 2280 Colony Way, Ypsilanti, MI 48197 (US). BRUSSOLO, John, Scott; 180 N. Mansfield, Ypsilanti, MI 48197 (US). (74) Agents: RYAN, M., Andrea; Warner-Lambert Company, 201 Tabor Road, Morris Plains, NJ 07950 (US) et al.		(81) Designated States: AM, AU, BG, BY, CA, CN, CZ, EE, FI, GE, HU, JP, KG, KR, KZ, LT, LV, MD, MX, NO, NZ, PL, RO, RU, SG, SI, SK, TJ, UA, UZ, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(54) Title: METHOD AND APPARATUS FOR SIMULTANEOUSLY TESTING A PLURALITY OF COMPOUNDS TO DETECT THEIR ACTIVITY			
(57) Abstract Described is a method of simultaneously testing a plurality of compounds for activity comprising the steps of: (a) placing a plurality of the compounds into at least two arrays, each having a plurality of test zones, with multiple compounds in each zone; (b) determining the location of each compound in each test zone; (c) subjecting the array to a testing screen; and (d) ascertaining those compounds that had a positive response to the testing screen. Also described is an apparatus for performing simultaneous testing of a plurality of compounds in a plurality of arrays containing the compounds to be tested for their activity.			

BEST AVAILABLE COPY

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

- 1 -

**METHOD AND APPARATUS FOR
SIMULTANEOUSLY TESTING A PLURALITY
OF COMPOUNDS TO DETECT THEIR ACTIVITY**

Technical Field

5 The invention pertains to the field of testing of compounds to ascertain their activity. The invention is particularly concerned with the laboratory testing of large quantities of compounds in a rapid manner.

Background Art

10 Many organizations, in particular pharmaceutical organizations, over many years have synthesized a number of compounds for various research projects. Accordingly therefore, a large collection of compounds have been collected which includes a database of their
15 structures and chemical properties. Frequently, these compounds are screened for biological assays to ascertain the activity of a compound with respect to the assay. A previous method of delivering the compounds involved selecting small numbers of compounds and
20 weighing out the individual samples which were then sent for a single screen. With the advent of automated screening technology, the delivery method became inadequate. A single screen could test hundreds of compounds in a day, while each technician dispensing samples could
25 only deliver a few dozen in a day.

 New equipment became available to speed up the testing techniques. One technique was to manually dispense estimated amounts of individual compounds into small tubes that fit into a 96-well plate format. While

-2-

automated equipment could dissolve the samples and mix them into the reaction wells, they still required a very substantial period of time to go through a screening process. The problem still remained as to how to have the substantial numbers of compounds to be screened for various assays. Preparation of the testing plates and the testing of the compounds per se was extremely labor intensive. It had previously been estimated that it would take almost a year to test approximately 100,000 compounds following this approach.

PCT Publication No. WO93/13423, published July 8, 1993, describes an automated analysis equipment and assay method for detecting cell surface protein and/or cytoplasmic receptor function. The publication teaches an automated measuring apparatus which can decrease substantial worker effort. The publication indicates that for each drug that needed to be screened, the materials were tested one by one, even though an automated apparatus permitted the rapid detection of activity for the compounds tested.

U.S. Patent No. 5,281,540 teaches a test array for performing assays. A semi-automated biological sample analyzer is described for simultaneously performing a plurality of enzyme immunoassays for human IgE class antibodies specific to a panel of preselected allergens in each of a plurality of biological samples. The technique, while having multiple biological samples in a well, uses a coating of an elongated cellulosic body such as a strip of paper which will contact the multiple samples to ascertain which antibodies are specific for the coated allergens and which will then, in turn, bind to the appropriate bands or islands. The bands or islands are then analyzed for the presence of

-3-

labeled antibodies. The technique describes testing done in a seriatim basis, namely, a number of samples, one after the other, even though multiple samples are present in a reaction vessel. The use of antibodies
5 which bind to a specific sample is required for the system to be effective. The samples may be detected by use of optical reading capabilities.

Other patents that test multiple compounds in a seriatim fashion utilizing automated equipment are
10 described in U.S. Patent Nos. 4,039,286 and 4,166,095.

It is an object of the present invention to simultaneously test a plurality of compounds utilizing at least two separate arrays of the same collection of compounds in each array.

15

Summary Of The Invention

Described is a method of simultaneously testing a plurality of compounds for activity comprising the steps of:

(a) placing a plurality of the compounds into
20 at least two arrays, each having a plurality of test zones, with multiple compounds in each zone;

(b) determining the location of each compound in each test zone;

(c) subjecting the array to a testing screen;
25 and

(d) ascertaining those compounds that had a positive response to the testing screen.

Also described is an apparatus for simultaneously determining the activity of a plurality of
30 compounds comprising:

-4-

(a) a first array of a plurality of test zones, each zone having an ability to contain a plurality of compounds to be tested;

5 (b) a second array of a plurality of test zones, each zone having an ability to contain a plurality of compounds to be tested;

(c) means for simultaneously testing the compounds in the test zones; and

10 (d) means for ascertaining which compound in each array has a positive response to a testing screen after it has been determined that a compound has tested positive or negative for the activity.

Brief Description Of The Drawings

15 FIGURE 1 is a schematic diagram showing the creation of the first array called an X plate utilized in the present invention;

FIGURE 2 is a schematic diagram showing the creation of the second array called a Y plate utilized in the present invention;

20 FIGURE 3 is a schematic diagram depicting the utilization of Figures 1 and 2 in the mass screening techniques of the present invention using an orthogonal array;

25 FIGURE 4 is a combination array of a single row A of the X and Y master plates of Figures 1 and 2; and

FIGURE 5 is a master plate activity report showing hypothetical activity for the X and Y plates.

Description of Preferred Embodiments

The present invention can generally be characterized as a mass screening technique using an orthogonal array method (see Figure 3). A simple plate (10) of Figures 1 and 2 utilizes ten columns across the top row A (of Figure 3). The outermost columns (1 and 12 column numbers) are not used or are used for controls. Therefore, 80 compounds (8 rows of A-H with ten columns of 2-11) are placed into a 96-well plate called a "simple plate". The X master plate (12) is made up by placing an aliquot from each well from simple plate #1 into column 2 of the X master plate (14) and continued for the remainder of the ten simple plates.

The Y master plate (16) is prepared by taking the same contents of the ten simple plates (10) and placing the contents of each plate on top of each other so that the rows and columns of each simple plate fit within the test wells of the Y master plate (the rows and columns are the same for simple plate and Y master plate).

A master plate containing 800 compounds (the X Plate 12), such as a 96-well plastic plate, is prepared. A Y-Plate (16), identified as the orthogonal array master plate, likewise can contain 800 compounds. As can be seen from Figure 3, if there is a compound that has activity such as hypothetical compound 727, it is present on the X Plate in well H4. On the Y Plate, it is found at well H8. Therefore, the activity has to correspond to a common compound, hypothetical compound 727 in this example. The method likewise is equally applicable for multiple active materials in a well.

-6-

In its most preferred feature, the current method is to make two plates that contain the same 800 compounds. One plate is the same as described above ("X Master plate"), and the other is arranged by turning the array of the first plate 90 degrees ("Y Master plate"). A Beckman robot was used to consolidate ten plates with one compound in each of 80 wells ("Simple Plate") using columns 2-11 and leaving columns 1 and 12 empty, into one plate with 10 compounds in each of 80 wells ("X Master plate") using columns 2-11 and leaving columns 1 and 12 empty (see Figure 1). The consolidation begins by transferring a 50 μ l aliquot from column 2 "Simple Plate" number one into column 2 of "X Master plate" number one, then transferring a 50 μ l aliquot from column 3 "Simple Plate" number one into column 2 of "X Master plate" number one, etc., ending with transferring a 50 μ l aliquot from column 11 "Simple Plate" number one into column 2 of "X Master plate" number one. The result is that an aliquot from each well of "Simple Plate" number one (10) exists in column 2 of "X Master plate" (12) number one (14). The same process is used for the remaining "Simple Plates" two through ten, such that an aliquot from each well of "Simple Plate" number two exists in column 3 of the "X Master plate", etc., ending with an aliquot from each well from "Simple Plate" number 10 existing in column 11 of the "X Master plate". The nature of the process ensures that every compound in row A of "Simple Plate" one through ten exists in row A of "X Master plate" number one, likewise through row H.

A Tomtec Quadra 96-100 (trademark of Tomtec, Inc. for automated well filling lab equipment) was used to consolidate each of the ten "Simple Plates" with one compound in each of 80 wells, into one plate with 10

-7-

compounds in each of 80 wells ("Y Master plate") using columns 2-11 and leaving columns 1 and 12 empty (Figure 2). The consolidation begins by transferring a 50 μ l aliquot from each of the 80 wells from "Simple Plate" number one into each of the 80 wells of "Y Master plate" number one, with the well location of the source "Simple Plate" matching the well location of the receiving "Y Master plate". This process continues for the remaining "Simple Plates" two through ten, such that an aliquot from each well of remaining simple plates is dispensed in the "Y Master plate", with the well location of the source "Simple Plate" matching the well location of the receiving "Y Master plate". The nature of the process ensures that every compound in row A of "Simple Plate" one through ten exists in row A of "Y Master plate" number one, likewise through row H. This process also ensures that the same 100 compounds are in row A of the "X Master plate" and in row A of the "Y Master plate", likewise through row H.

Both the "X Master plate" and the "Y Master plate" have 10 compounds in each well while each compound appears once on each plate. However, no two compounds have the same pair of well locations. When the plates are tested and the results compared, the individual compounds responsible for any activity can be determined. For convenience of assigning a location for each well, Applicant has devised an array combining the X and Y plates as shown in Figure 4 which is an array of 10x10. For example, after testing "X Master plate" #1, well A2 is determined to be active (containing compounds 1 through 10, inclusive) and after testing "Y Master plate", well A11 is determined to be active (containing compounds 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100). Only compound number 10 is common between the two wells

-8-

determined to be active. Therefore, compound number 10 is assumed to be the active compound. Figure 3 shows a similar hypothetical arrangement. If multiple wells are found in one row on one of the two plates and a single well is found on the corresponding row on the other plate, then one can ascertain the active compounds. For example, if, in addition to the active wells stated above, well A3 from the "X Master plate" is determined to be active (containing compounds 11 through 20, inclusive), then both compound number 10 and compound number 20 are common between the two plates. When multiple wells are determined to be active in the same row on both plates, then estimates may be made of the active material. That is, if well A2 and well A11 from both plates were determined to be active, then compounds number 1, 10, 91 and 100 would be derived from the orthogonal array. However, if only compound numbers 1 and 100 were active, the same four wells would show activity; likewise if only compound numbers 10 and 91 were active.

The advantage of this, even given the probability of testing inactive compounds, is that the biological testers can go directly to quantitative screening with individual compounds. There is no need to create plates that contain the individual compounds. The same plate pairs can be sent to multiple screens, without need to create differently arranged plates for each screen.

How to Identify the "Hit" **Compounds From the X Y Plate Results**

In this system, each row can be treated as a distinct entity. That is, any compound that is in row

-9-

C on a simple plate, will also fall in row C on both the X plate and the Y plate. The same 100 compounds are in row C on both the X plate and the Y plate. There is no overlap between rows. So each master plate set actually carries eight completely separate 100 compound arrays.

Compounds in all types of plates are dissolved in DMSO (dimethyl sulfoxide), which means they can be transferred using pipeting rather than as solids, which makes it much easier to handle the mixing of very small amounts. However, for follow-up screening of the hit compounds, individual samples are weighed out dry from the sample collection. It is to be appreciated that any inert solvent may be used that is compatible with the testing screen. Such solvents include water, dimethyl formamide, N-methylpyrrolidone, glycols such as diethylene glycol, and the alkyl ether derivatives or the lower alkyl ester derivatives such as the Cellosolve solvents (trademark of Union Carbide).

A Master Plate Activity Report (Figure 5) shows the hypothetical test results on the X and Y master plates.

On the X plate report (20), in row C, there were two hits, in column 3 and in column 9. Now review the list of plate contents shown below in Table I.

Since the columns in the X plate were filled in order from left to right, with aliquots from simple plates in numerical order, we know that all ten compounds in well 3C on the X plate came from simple plate 1181, and they were all in row C. This narrows the choice to ten compounds from the content list, marked as "pink".

-10-

On the Y plate, in row C, there were also two hits, in columns 5 and 9. Turn to the list of plate contents again. Since the wells in the Y plate were all filled using aliquots from the same wells in the simple plates, we can scan the list of plate contents for all compounds in well 5C, in any simple plate, marked as "yellow".

Now compare the compounds that were marked. The only compound that was marked "pink" and "yellow", was in simple plate 1181, well 5C. The number of this compound is 108240.

When only one well is checked on each plate, in a given row, then its easy to narrow the hit to one compound. It is a little more complicated when two wells are checked on each plate, in a given row.

Look back at row C on the X plate. There were two boxes checked. Using the same method to locate all the compounds in the X plate's well 3C, the compounds in well 9C are marked as "green". All the compounds in the X plates' column 9 came from simple plate 1187. It is seen that one of these ten compounds is also marked as "yellow", because it was in well 5C in the Y plate.

Now look again at row C on the Y plate. There were two boxes checked there as well. The second box checked was 9C. Using the same method to locate all the compounds in the Y plate's well 5C, all the compounds from 9C have been marked as "blue". Each of the compounds in the Y plate's well 9C was also in well 9C on the simple plates it came from. It is seen that not only is one of these compounds marked as "green", there is also one that is marked as "pink".

-11-

So, there are four compounds that were marked twice. Therefore, four hits need to be followed up on. Each of the twice-marked compounds had one mark because it was in a Y plate hit well, and one mark because it was in an X plate hit well. The number of hits in a given row, is actually the product of the number of hits in that row in the X plate multiplied by the number of hits in that row in the Y plate.

Table I

	<u>Plate</u> <u>No.</u>	<u>Col.</u>	<u>Row</u>	<u>Compound #</u> <u>Tested</u>
10	1180	2	A	100001
	1180	2	B	100002
	1180	2	C	100003
15	1180	2	D	100004
	1180	2	E	100005
* * *				
	1180	4	G	107917
	1180	4	H	107918
20	1180	5	A	107921
	1180	5	B	107923
	1180	5	C	107924 Yellow
	1180	5	D	107934
	1180	5	E	107935
25	* * *			

-12-

	<u>Plate No.</u>	<u>Col.</u>	<u>Row</u>	<u>Compound # Tested</u>	
5	1180	9	A	108022	
	1180	9	B	108031	
	1180	9	C	108037	Blue
	1180	9	D	108050	
* * *					
10	1181	2	A	108145	
	1181	2	B	108147	
	1181	2	C	108151	Pink
	1181	2	D	108154	
	1181	2	E	108160	
* * *					
15	1181	3	A	108169	
	1181	3	B	108171	
	1181	3	C	108172	Pink
	1181	3	D	108174	
	1181	3	E	108175	
* * *					
20	1181	4	A	108190	
	1181	4	B	108194	
	1181	4	C	108197	Pink
	1181	4	D	108200	
	1181	4	E	108206	
* * *					
25	1181	5	A	108238	
	1181	5	B	108239	
	1181	5	C	108240	Pink-Yellow
	1181	5	D	108241	
	1181	5	E	108242	
* * *					
30	1181	6	B	108255	
	1181	6	C	108259	Pink
	1181	6	D	108261	
	1181	6	E	108268	
* * *					
35	1181	6	B	108255	
	1181	6	C	108259	Pink
	1181	6	D	108261	
	1181	6	E	108268	

* * *

-13-

	<u>Plate No.</u>	<u>Col.</u>	<u>Row</u>	<u>Compound # Tested</u>	
5	1181	7	A	108290	
	1181	7	B	108295	
	1181	7	C	108296	Pink
	1181	7	D	108302	
	1181	7	E	108306	
* * *					
10	1181	8	B	108331	
	1181	8	C	108332	Pink
	1181	8	D	108334	
	1181	8	E	108335	
* * *					
15	1181	9	B	108355	
	1181	9	C	108357	Blue-Pink
	1181	9	D	108366	
	1181	9	E	108379	
* * *					
20	1181	10	B	108418	
	1181	10	C	108426	Pink
	1181	10	D	108428	
	1181	10	E	108433	
* * *					
25	1181	11	B	108445	
	1181	11	C	108446	Pink
	1181	11	D	108451	
	1181	11	E	108452	
* * *					
30	1182	5	A	108569	
	1182	5	B	108571	
	1182	5	C	108578	Yellow
	1182	5	D	108585	
* * *					
35	1182	9	A	108769	
	1182	9	B	108771	
	1182	9	C	108779	Blue
	1182	9	D	108788	

-14-

	<u>Plate No.</u>	<u>Col.</u>	<u>Row</u>	<u>Compound # Tested</u>
			* * *	
5	1183	5	A	109116
	1183	5	B	109125
	1183	5	C	109126 Yellow
	1183	5	D	109132
			* * *	
10	1183	9	A	109271
	1183	9	B	109272
	1183	9	C	109277 Blue
	1183	9	D	109278
			* * *	
15	1184	5	A	109509
	1184	5	B	109510
	1184	5	C	109511 Yellow
	1184	5	D	109513
			* * *	
20	1184	9	A	109659
	1184	9	B	109666
	1184	9	C	109667 Blue
	1184	9	D	109672
			* * *	
25	1185	5	A	109933
	1185	5	B	109940
	1185	5	C	109941 Yellow
	1185	5	D	109942
			* * *	
30	1185	9	A	110082
	1185	9	B	110089
	1185	9	C	110096 Blue
	1185	9	D	110097
			* * *	

-15-

	<u>Plate No.</u>	<u>Col.</u>	<u>Row</u>	<u>Compound # Tested</u>	
5	1186	5	A	110270	
	1186	5	B	110272	
	1186	5	C	110275	Yellow
	1186	5	D	110276	
	* * *				
10	1186	9	A	110420	
	1186	9	B	110421	
	1186	9	C	110422	Blue
	1186	9	D	110423	
	* * *				
15	1187	2	A	110525	
	1187	2	B	110527	
	1187	2	C	110529	Green
	1187	2	D	110538	
	* * *				
20	1187	3	A	110567	
	1187	3	B	110568	
	1187	3	C	110582	Green
	1187	3	D	110584	
	* * *				
25	1187	4	A	110595	
	1187	4	B	110596	
	1187	4	C	110598	Green
	1187	4	D	110604	
	* * *				
30	1187	5	A	110612	
	1187	5	B	110614	
	1187	5	C	110616	Yellow-Green
	1187	5	D	110617	
	* * *				
35	1187	6	A	110639	
	1187	6	B	110644	
	1187	6	C	110650	Green
	1187	6	D	110652	

* * *

-16-

	<u>Plate No.</u>	<u>Col.</u>	<u>Row</u>	<u>Compound # Tested</u>	
5	1187	7	A	110674	
	1187	7	B	110676	
	1187	7	C	110684	Green
	1187	7	D	110685	
	* * *				
10	1187	8	A	110702	
	1187	8	B	110707	
	1187	8	C	110713	Green
	1187	8	D	110716	
	* * *				
15	1187	9	A	110747	
	1187	9	B	110749	
	1187	9	C	110750	Blue-Green
	1187	9	D	110760	
	* * *				
20	1187	10	A	110793	
	1187	10	B	110803	
	1187	10	C	110807	Green
	1187	10	D	110809	
	* * *				
25	1187	11	A	110825	
	1187	11	B	110836	
	1187	11	C	110838	Green
	1187	11	D	110841	
	* * *				
30	1188	5	A	110936	
	1188	5	B	110940	
	1188	5	C	110941	Yellow
	1188	5	D	110945	
	* * *				
35	1188	9	A	111051	
	1188	9	B	111052	
	1188	9	C	111053	Blue
	1188	9	D	111054	

* * *

-17-

	<u>Plate No.</u>	<u>Col.</u>	<u>Row</u>	<u>Compound # Tested</u>
	1189	5	A	111249
	1189	5	B	111260
5	1189	5	C	111261 Yellow
	1189	5	D	111262

* * *

The number of compounds in each test well can vary from 5 to 20, preferably 8-12/well or zone. Ten compounds per well may be an optimum number. If the number of compounds in each well is increased, the number of active wells will increase, and the number of compounds that need to be followed up increases exponentially. However, if three or more arrays (such as a "Z" plate) were used, then more compounds per well could be inserted. The Z plate could be arranged 90° from the "Y" plate for convenience.

Mathematically, the determination of a "hit" can be expressed as follows. Each compound involved in the screening can be uniquely represented by three variables (i,j,k), where k is the simple plate in which the compound is located, and i and j are the row and column, respectively, in which the compound is located in the kth simple plate. Using these variables, a matrix $S_k[i,j]$ representative of the compounds located on the kth simple plate can be formed. Thus, ten matrices can be formed for the embodiment using 800 compounds located on ten simple plates: $S_1[i,j]$, $S_2[i,j]$, ..., $S_{10}[i,j]$. Since eight rows and ten columns are employed on each simple plate in this embodiment, the variable i ranges from 1 to 8 and the variable j ranges from 1 to 10.

The X plate and Y plate are also represented by matrices, namely $X[i,j]$ and $Y[i,j]$. The $X[i,j]$ and

-18-

Y[i,j] matrices are based upon the matrix representation $S_k[i,j]$ of the compounds in the ten simple plates. Specifically, the ten compounds within the ith row and jth column of the X plate are represented by $S_1[i,1]$, $S_1[i,2]$, $S_1[i,3]$, ..., $S_1[i,10]$. Similarly, the ten compounds within the ith row and jth column of the Y plate are represented by $S_1[i,j]$, $S_2[i,j]$, $S_3[i,j]$, ..., $S_{10}[i,j]$.

As a result, it can be seen that the compound represented by (i,j,k) is located in row i, column k of the X plate, and in row i, column j of the Y plate. This means that a hit due to the compound located in row i, column j of the kth simple plate results in a hit in row i, column k of the X plate, and a hit in row i, column j of the Y plate. Inversely, a hit observed in row i, column k of the X plate and a hit in row i, column j of the Y plate is potentially due to the (i,j,k) compound.

Visually, when a hit is observed at a well in the Y plate, one can conclude that the hit resulted due to an active compound located at the same well location in one of the ten simple plates. A hit in the same row of the X plate can then be used to determine which of the ten simple plates contains the active compound. Specifically, the column number of the hit represents the simple plate which contains the active compound.

Pseudo-code for a procedure for determining the potentially active compounds is as follows.

Do for each row $i = 1, 2, \dots, 8$:
Let k_1, k_2, \dots be the column numbers of the hits in row i of X plate;

-19-

Let j_1, j_2, \dots be the column numbers of the hits in row i of the Y plate;

The potentially active compounds are $(i, j_1, k_1), (i, j_1, k_2), (i, j_2, k_1), (i, j_2, k_2), \dots$

5 10 simple plates : $S, [i, j], S_2[i, j], \dots, S_{10}[i, j]$

where $i = 1, 2, \dots, 8$

$j = 1, 2, \dots, 10$

$[i, j]$:

10

$[1, 1]$	$[1, 2]$	$[1, 3]$	\dots	$[1, 10]$
$[2, 1]$	$[2, 2]$	$[2, 3]$	\dots	$[2, 10]$
$[3, 1]$	$[3, 2]$			
\vdots	\vdots			\vdots
$[8, 1]$	$[8, 2]$	\dots		$[8, 10]$

For X plate:

15 $x[i, j] = S_j [i, 1] + S_j [i, 2] + S_j [i, 3] + \dots + S_j [i, 10]$

$$= \sum_{k=1}^{10} S_j [i, k]$$

For Y plate:

20 $y[i, j] = S_1[i, j] + S_2[i, j] + S_3[i, j] + \dots + S_{10}[i, j]$

$$= \sum_{k=1}^{10} S_j [i, k]$$

25 \therefore code each compound as $(i, j, k) \leftrightarrow S_k[i, j]$
 \leftrightarrow row i , column j of plate k

This compound is in : row i , column k of X plate, and
row i , column j of Y plate.

30 \Rightarrow Inversely, if there is a hit for $x[i, j]$ and a hit for $y[i, j]$, then the compound in $S_k[i, j]$ may be the cause.

The current technique for screening large numbers of compounds is applicable for a variety of screens, most preferably biological screenings. By a

-20-

screen is meant a biological assay that is developed to determine the biological activity of a material.

The collection of materials that are available may be tested against an assay. In this fashion, it can be said that a database of materials can be screened for a particular assay to determine the activity of the portions of the database underneath the assay.

For example, an assay may be followed to determine if a material may be a cholesteryl ester transfer protein inhibitor (CETP). The test is described as follows.

CETP is a 74 kDa plasma glycoprotein responsible for the reciprocal exchange of neutral lipids between circulating lipoproteins. Net alteration in lipoprotein core lipid composition is a complex process. The modifications are influenced by lipoprotein concentration, lipoprotein residence time, and the activities of lecithin:cholesteryl acyl transferase (LCAT), hepatic lipase, lipoprotein lipase, and CETP. In general, in species lacking CETP activity, and humans genetically-deficient in CETP, the equilibrium favors elevation of anti-atherogenic (HDL) and diminution of atherogenic (LDL) lipoproteins. Therefore, plasma CETP inhibition could be an advantageous pharmacological target for the treatment of dyslipidemic patients at risk for coronary heart disease.

Recent studies of a Japanese family with deficiency in plasma CETP have shown that the deficiency was associated with marked elevation of HDL, its associated apolipoproteins (apoA-I, apoE, apoA-IV) and a rarity of coronary artery disease. The defect has been

-21-

identified as a G (guanine) to A (adenine) substitution in the fourteenth intron of CETP pre-messenger RNA (ribonucleic acid). This splice donor defect is also the cause of the deficiency in additional Japanese families identified. In other studies, the deficiency (both homozygous and heterozygous) has been shown to be associated with a large proportion of Japanese with hyperalphalipoproteinemia.

Also, a missense mutation at nucleotide 1506 (G for A) has been identified in exon 15 of the CETP gene, resulting in a substitution of a glycine for aspartic acid at amino acid 442. The two subjects heterozygous for the missense mutation had three times the normal HDL (high density lipoprotein) levels. Overall, these studies suggest that even partial reduction in CETP levels, as found in heterozygous individuals, is associated with elevated HDL. This apparently benign condition (CETP deficiency) has been coined the "longevity syndrome".

A variety of species, which lack CETP activity, including mice, rats, and dogs, have HDL as their major lipoprotein. When fed atherogenic diets, transgenic mice expressing human or cynomolgus monkey CETP develop atherogenic lipoprotein profiles, including elevation of apoB containing lipoproteins (VLDL and β -VLDL) and reduction of HDL. These mice also develop atherosclerotic lesions. In the transgenic mice, CETP plasma activity has also been shown to be directly correlated with apoB and inversely correlated with apoA-I levels. Infusion of antibodies to CETP into rabbits results in a more favorable lipoprotein profile, including elevated HDL cholesterol and particle size. Conversely, infusion of CETP into rats results in a less

-22-

favorable lipoprotein profile, including elevation of VLDL and LDL cholesterol and apoB, and diminution of apoE-rich HDL cholesterol and HDL size.

Preparation of CETP

5 The $d > 1.21$ g/ml fraction was isolated from rabbit (Pel-Freez Biologicals, Rogers, AR) or human plasma and dialyzed against 50 mM Tris, 150 mM NaCl, 2mM EDTA (ethylene diamine tetracetic acid), pH 7.4 buffer (1XDB, pH 7.4). Aliquots were stored frozen at -20°C .
10 Chinese Hamster Ovary cells transfected with human recombinant CETP may be obtained by license agreement from Columbia University, New York. Media from these cells grown in 10% fetal bovine serum in Hams F-12 was used as a source of human CETP without further purification.
15 The human CETP inhibitory monoclonal antibody TP2 (Mab TP2) may be obtained from Dr. Ross Milne and Yves Marcel (University of Ottawa Heart Institute). Mab TP2 is also known to inhibit rabbit CETP.

Radioisotopic Whole Plasma CETP Assays

20 Inhibitor screens were performed in 102.5 or 205 μl total volumes in deep 96-well polypropylene plates (1.2 ml capacity/well) or glass tubes, respectively. Compounds (final concentrations up to 100 μM) were added in 2.5 or 5.0 μl DMSO and pre-incubated for
25 1 hour at 37°C with previously frozen human plasma (25 or 50 μl). ^3H -CL-HDL₃ (20,000 or 40,000 dpm) in 75 or 150 μl of 1XDB, pH 8.0 was added and incubated at 37°C . Wells were harvested periodically up to 24h by the addition of a 1.0 ml solution (per 102.5 μl incubation)
30 containing 10 mg/ml bovine serum albumin, 1.29 mg/ml bovine intestinal mucosa heparin (Sigma Chemical Co.,

-23-

St. Louis, MO) in 0.14 M $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ in 1XDB pH 8.0. Samples were mixed and after 10 minutes centrifuged at 2200 rpm for 30 minutes at 10°C in an IEC PR-6000 centrifuge to precipitate apoB containing lipoproteins.

5 Supernatant aliquots were counted by liquid scintillation spectroscopy to determine radioactivity remaining in HDL_3 . See JOURNAL OF LIPID RESEARCH, Vol. 34, 1993, pp. 1625-1634, entitled "Use of Fluorescent Cholesteryl Ester Microemulsions and Cholesteryl Ester Transfer

10 Protein Assays" by C.L. Bisgaier et al.

The invention herein may likewise be used in the spectrophotometric microtiter-based assay for the detection of hydroperoxy derivatives of linoleic acid. See, ANALYTICAL BIOCHEMISTRY, 201, 375-380 (1992) by B.J.

15 Auerbach et al.

An assay for the detection of hydroperoxy derivatives of linoleic acid formed by the action of 15-lipoxygenase is described. The assay developed is based on a method first reported by Ohishi et al (1985) BIOCHEM.

20 INT. 10, 205-211, with some modifications. The assay described herein takes advantage of the ability of (9Z,11E)-13-hydroperoxyoctadecadienoic acid (13-HPODE), the product of the action of 15-lipoxygenase on linoleic acid, to oxidize N-benzoyl leucomethylene blue to

25 methylene blue in the presence of hemoglobin. The resultant blue color is stable to light and air and can be quantified spectrophotometrically at 660 nm. The linear range of the assay is 1.6 - 3.2 nmol (0.5 - 10 μg) of 13-DPODE. The utility of the assay can be

30 extended to detect other peroxides as well as inhibitors of 15-lipoxygenase. The assay is a rapid, reliable method for the detection of lipid hydroperoxide production.

-24-

The methods and the materials utilized for this assay are as follows:

Materials. The following chemicals were purchased and used as received: linoleic acid (NuCheck Prep), 13(S)-HPODE, NDGA (nordihydroguaiaretic acid), ETYA (5,8,11,14-Eicosatetraynioc acid), 14,15-methano-LTA₄ (leukotriene A₄), (Biomol Research Labs), N-benzoyl leucomethylene blue (Tokyo Kasei Kogyo Co., Ltd.), dimethylformamide (DMF; Aldrich), sodium cholate, Triton X-100, 30% H₂O₂, 70% t-butyl hydroperoxide, and hemoglobin, bovine (Sigma). Probucol and indomethacin were prepared at Parke-Davis.

Methylene Blue Method For Peroxide Detection. The assay is performed in a 96-well microtiter plate. Each well contains 40 μ l of substrate solution consisting of 160 μ M linoleic acid, 5% ethanol, 0.2% sodium cholate in PBS without EDTA, inhibitor, if included, and 0.16 U enzyme isolated from phenylhydrazine-treated rabbit reticulocyte preparations (21) [1 U=1 nmol linoleic acid utilized/min at 4°C] for a total volume of 50 μ l. The plate is then incubated at 4°C for 10 minutes followed by the addition of 100 μ l of LMB color reagent consisting of 5 mg LMB dissolved in 8 ml DMF, which is then added to a 0.05 M potassium phosphate buffer (pH 5) containing 1.4 g Triton X-100 and 5.5 mg hemoglobin in a total volume of 100 ml. After 5 minutes at room temperature, the samples can be read at 660 nm on a microtiter plate reader. Under these conditions, approximately 20% of the substrate is converted to product.

HPLC (High Pressure Liquid Chromatography) Method For 13(S)-HPODE Detection. For verification of

-25-

the assay, HPLC analysis of the products was performed after incubation under the above-described conditions. The assay is terminated by the addition of an equal volume HPLC mobile phase (acetonitrile:water:methanol:acetic acid, 350:250:150:1). The samples are then injected onto a C18 column (Perkin-Elmer) with conjugated dienes monitored at 235 nm and keto-derivatives at 270 nm. A postcolumn chemiluminescence reaction was utilized to detect hydroperoxy fatty acid derivatives.

10 The invention can likewise be used for determining the epidermal growth factor receptor kinase activity.

 The present invention may be used as an assay for Acetylcholinesterase (AChE) activity. See, for example, the Ellman method (Ashour et al, 1987, ANAL. BIOCHEM. 166, 353-360).

 The invention may equally be useful as an assay for mutant reverse transcriptase. This test is a determination of inhibitors of viral DNA polymerase and reverse transcriptase. See, VIROLOGY, 114, 52 (1981) entitled "Mechanism of Inhibition of Epstein-Barr Virus Replication" by A.K. Datta et al.

 The present invention can be used in an RNA enzyme assay system. The assay is a commercially available assay from Amersham entitled "RNase H(3H)-SPA Enzyme Assay System".

 The test is equally applicable for looking for inhibitors of Hepatitis B virus. A typical technique is called Hepatitis B virus reverse transcriptase assay.

-26-

The assay procedure is a commercially available assay procedure.

5 The invention is equally applicable to detect HIV protease enzyme. There is a commercially available testing identified as Amersham's HIV protease [125]I-SPA assay system.

10 The invention is equally applicable to determining the ability of materials for rust-removing activity, or the ability to dye various textile materials, or the ability to clean substrates, or the ability of material to decompose in the presence of bacteria such as soiled bacteria and the like.

15 The invention is equally applicable to determining a compound's ability to hybridize to a library of genes, or whether particular materials are sensitive to mammals and the like.

-27-

The invention is equally applicable to determining sunscreens activity or immune response in mammals. Various Elisa (enzyme link immuno sorbant activity) which enzyme can detect for the presence of a number of biologic materials such as various components of the blood such as T-cells, B-cells, interleukins, and the like.

The invention is equally applicable for determining the presence or absence of a gene which is associated with a particular malady or a gene that is associated with an absence of a biological response in mammals. The test could be applicable for determining the permeability of materials to a membrane such as a cellular membrane. The test is applicable for determining the activity of a cell to transduce signals over the ability of different materials to bind two cells or to bind enzymes or antibodies. See, CELLULAR AND MOLECULAR IMMUNOLOGY (2nd Edition) 1994 by A.K. Abbas, pp. 56-60.

It is to be appreciated that a wide variety of a compound's activities could be determined such as:

the activity to be tested of the compounds is a rust remover activity;

the activity is the ability to dye textile materials;

the activity is to clean substrates;

the activity is the ability to decompose in the presence soil bacteria;

the activity is the ability of compounds to hybridize to a library of genes;

the activity is the ability to detect sun screen activity; the sun screens are also detected for sensitivity to mammals;

-28-

the activity is the ability to induce an immune response in mammals;

the activity is presence of a gene associated with a malady;

5 the activity is absence of a gene associated with a malady;

the activity is presence of a gene associated with a biological response in mammals;

10 the activity is the absence of a gene associated with a biological response in mammals;

the activity is permeability of a membrane;

the activity is effecting a signal transduction of a cell;

the activity is ability to bind to a cell;

15 the activity is ability to bind to an enzyme;
and

the activity is ability to bind to an antibody.

20 The present invention is equally applicable to determining an optimized dosage or weight for active compounds. In other words, the present invention can assist in quantitatively determining active materials and their degree of activity. In this manner, identical or differential amounts of a compound(s) to be tested
25 are placed in various unique well locations.

For a discussion of applicability of the present invention to the simultaneous synthesis of compositions, reference may be made to the concurrently filed patent application entitled "A Method for the
30 Synthesis of Mixtures of Compounds" commonly owned, attorney's case #PD5116, Serial No. _____, hereby incorporated by reference.

-29-

While the forms of the invention herein disclosed constitute presently preferred embodiments, many others are possible. It is not intended herein to mention all of the possible equivalent forms or ramifications of the invention. It is understood that the terms used herein are merely descriptive rather than limiting and that various changes may be made without departing from the spirit or scope of the invention.

-30-

What Is Claimed Is:

1. A method of simultaneously testing a plurality of compounds for activity comprising the steps of:

5 (a) placing a plurality of the compounds into at least two arrays, each having a plurality of test zones, with multiple compounds in each zone;

(b) determining the location of each compound in each test zone;

10 (c) subjecting the array to a testing screen; and

(d) ascertaining those compounds that had a positive response to the testing screen.

15 2. The method of claim 1 wherein at least one identical compound to be tested is placed in each array.

3. The method of claim 1 wherein there are more than two arrays.

20 4. The method of claim 1 wherein there are at least three arrays.

5. The method of claim 1 wherein the activity to be tested of the compounds is a rust remover activity.

25 6. The method of claim 1 wherein the activity is ability to dye textile materials.

7. The method of claim 1 wherein the activity is to clean substrates.

-31-

8. The method of claim 1 wherein the activity is the ability to decompose in the presence of soil bacteria.

5 9. The method of claim 1 wherein the activity is the ability of compounds to hybridize to a library of genes.

10. The method of claim 1 wherein the zones contain variations in the concentration of compounds tested.

10 11. The method of claim 1 wherein the activity is ability to detect sun screen activity.

12. The method of claim 11 wherein the sun screens are detected for sensitivity to mammals.

15 13. The method of claim 1 wherein the activity is the ability to induce an immune response in mammals.

14. The method of claim 1 wherein the activity is presence of a gene associated with a malady.

20 15. The method of claim 1 wherein the activity is absence of a gene associated with a malady.

16. The method of claim 1 wherein the activity is presence of a gene associated with a biological response in mammals.

25 17. The method of claim 1 wherein the activity is the absence of a gene associated with a biological response in mammals.

-32-

18. The method of claim 1 wherein the activity is permeability of a membrane.

19. The method of claim 1 wherein the activity is effecting a signal transduction of a cell.

5 20. The method of claim 1 wherein the activity is ability to bind to a cell.

21. The method of claim 1 wherein the activity is ability to bind to an enzyme.

10 22. The method of claim 1 wherein the activity is ability to bind to an antibody.

23. The method of claim 1 wherein the activity is to determine a cholesteryl ester transfer protein inhibitor.

15 24. The method of claim 1 wherein the activity is a kinase activity.

25. The method of claim 1 wherein the activity is an epidermal growth factor receptor kinase inhibitor.

20 26. The method of claim 1 wherein the activity is an acetylcholinesterase activity.

27. The method of claim 1 wherein the activity is a reverse transcriptase activity.

28. The method of claim 1 wherein the activity is a ribonucleic acid enzyme assay activity.

-33-

29. The method of claim 1 wherein the activity is a hepatitis B virus inhibitor.

30. The method of claim 1 wherein the activity is a human immunovirus protease enzyme.

5 31. The method of claim 1 wherein the activity is a human immunovirus protease activity.

32. The method of claims 1 or 2 wherein the number of compounds to be tested in each test zone ranges from 5 to 20 per zone.

10 33. The method of claims 1 or 2 wherein the number of compounds to be tested in each test zone ranges from 8 to 12 per zone.

34. An apparatus for simultaneously determining the activity of a plurality of compounds comprising:

15 (a) a first array of a plurality of test zones, each zone having an ability to contain a plurality of compounds to be tested;

 (b) a second array of a plurality of test zones, each zone having an ability to contain a plurality of compounds to be tested;

20 (c) means for simultaneously testing the compounds in the test zones; and

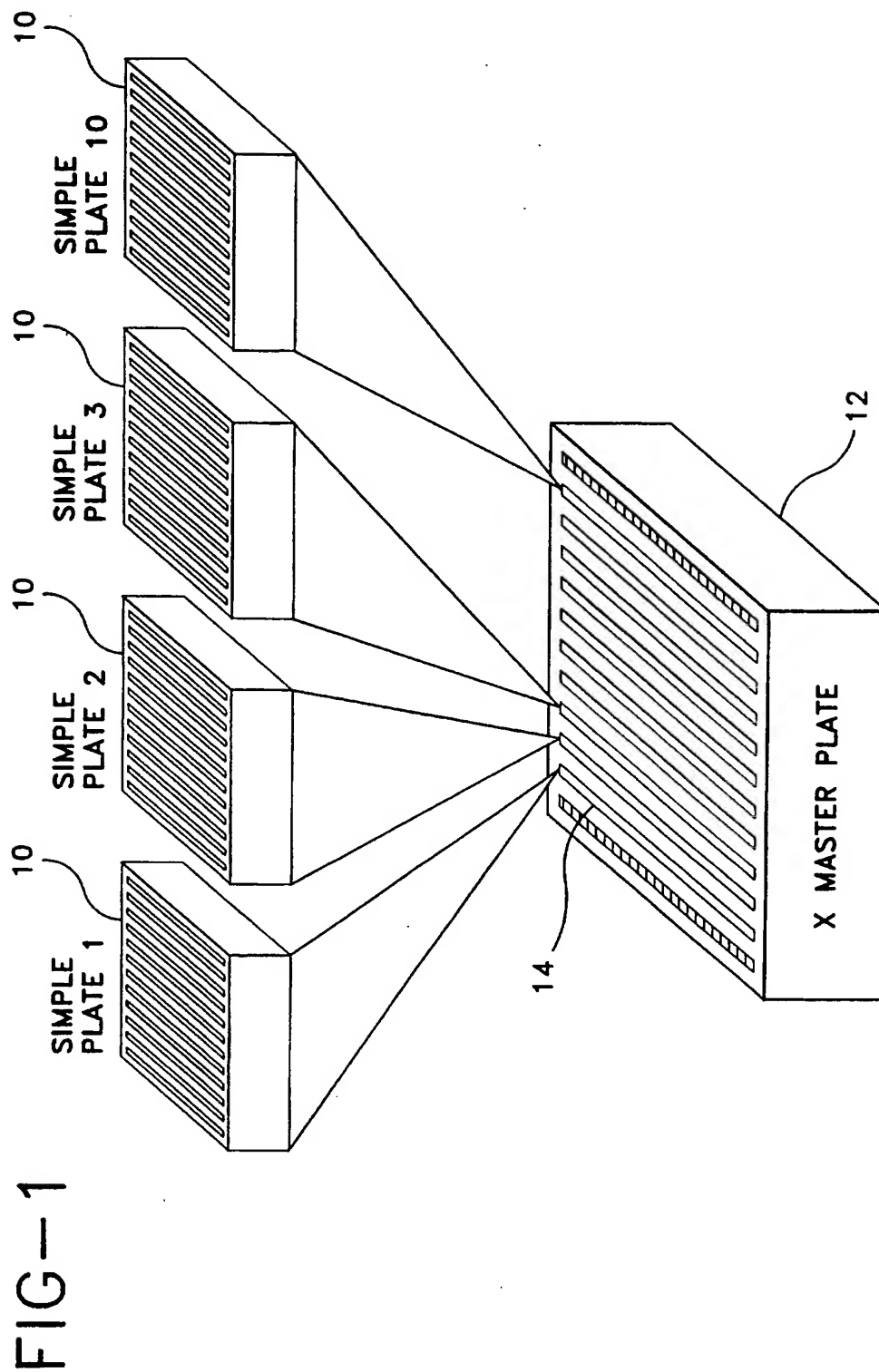
 (d) means for ascertaining which compound in each array has a positive response to a testing screen after it has been determined that a compound has tested positive or negative for the activity.

35. The apparatus of claim 34 wherein the means for ascertaining the compounds is a computer.

-34-

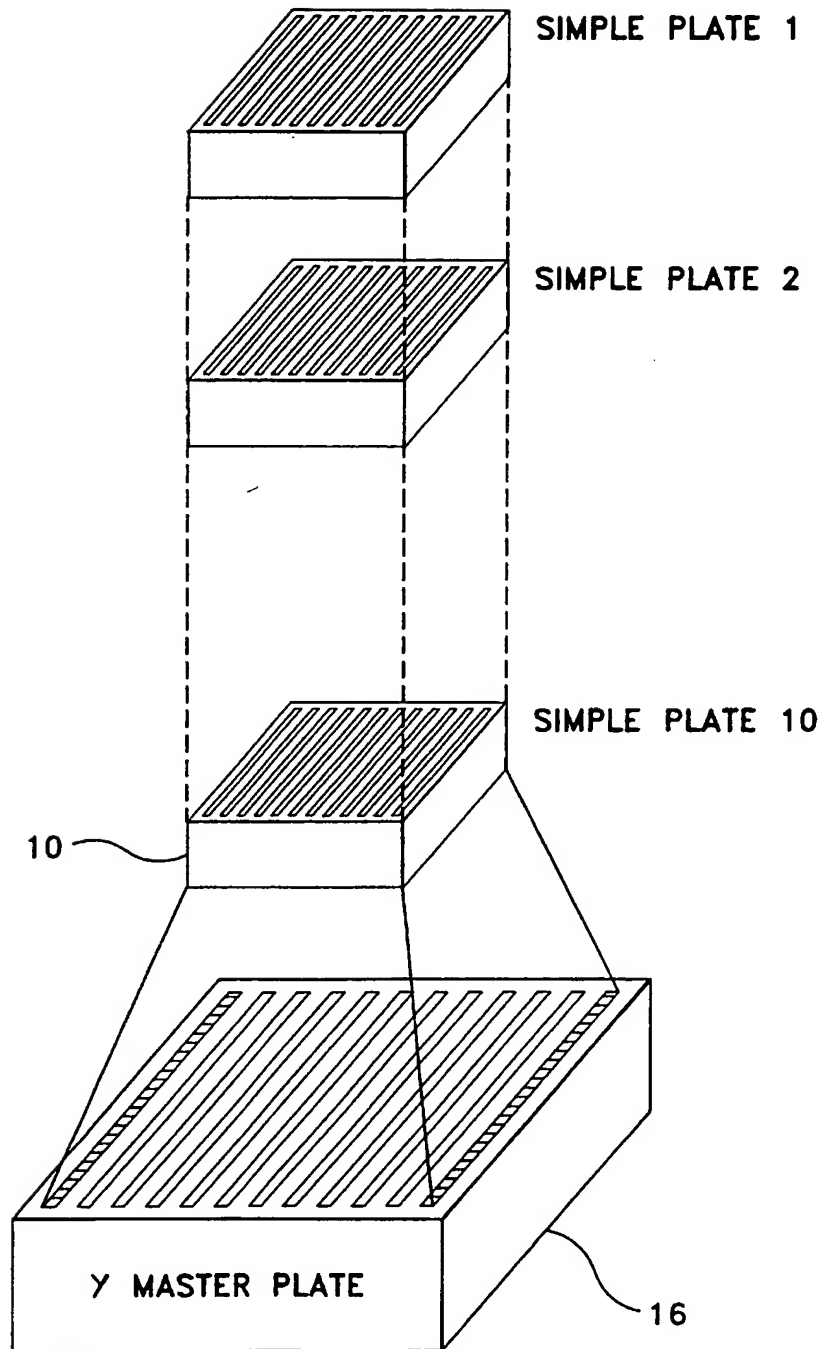
36. The method of claim 1 further comprising ascertaining a quantitative determination of compound activity by placing in different test zones identical or differential amounts of compounds being tested.

1/5

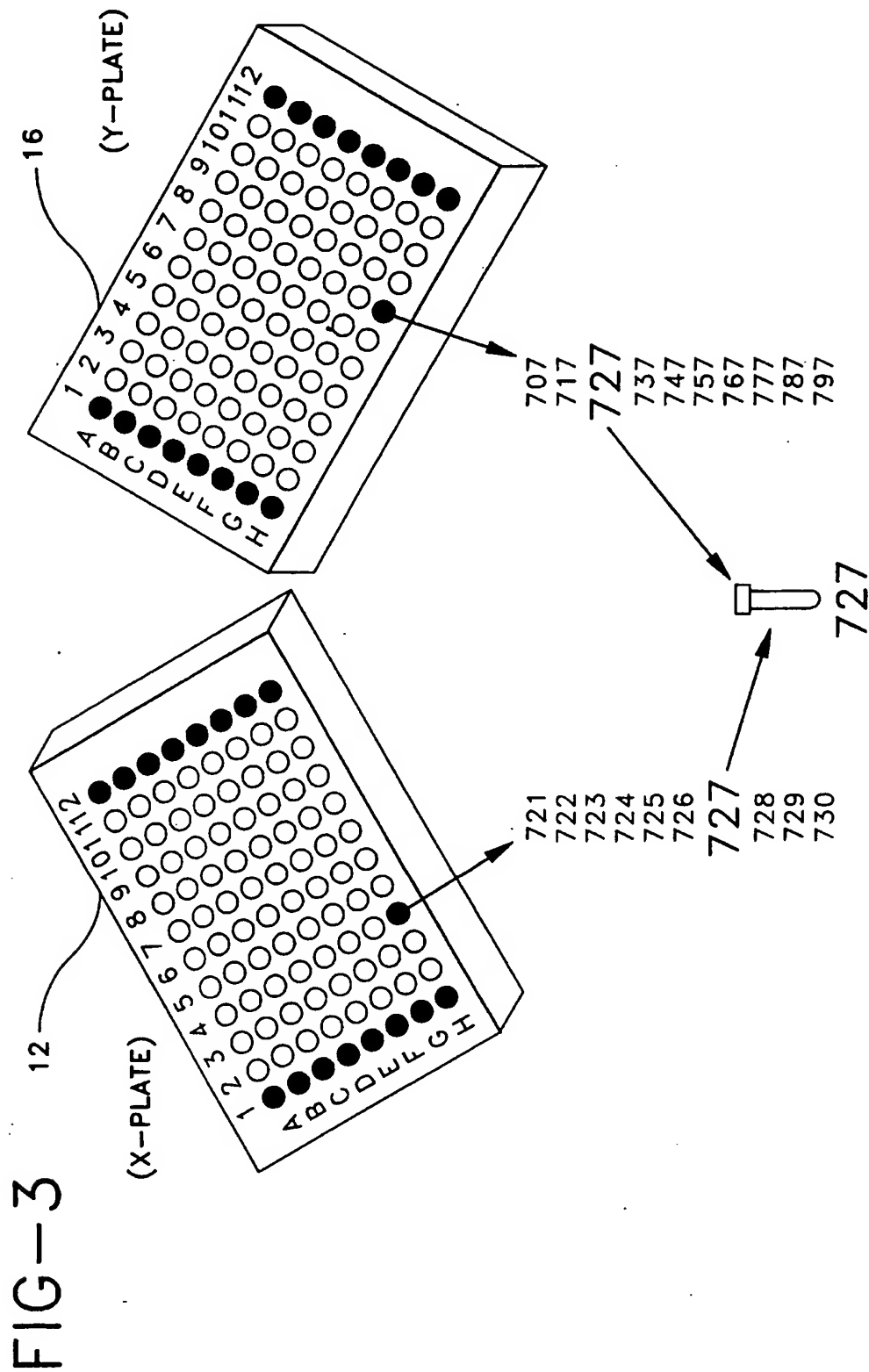


2/5

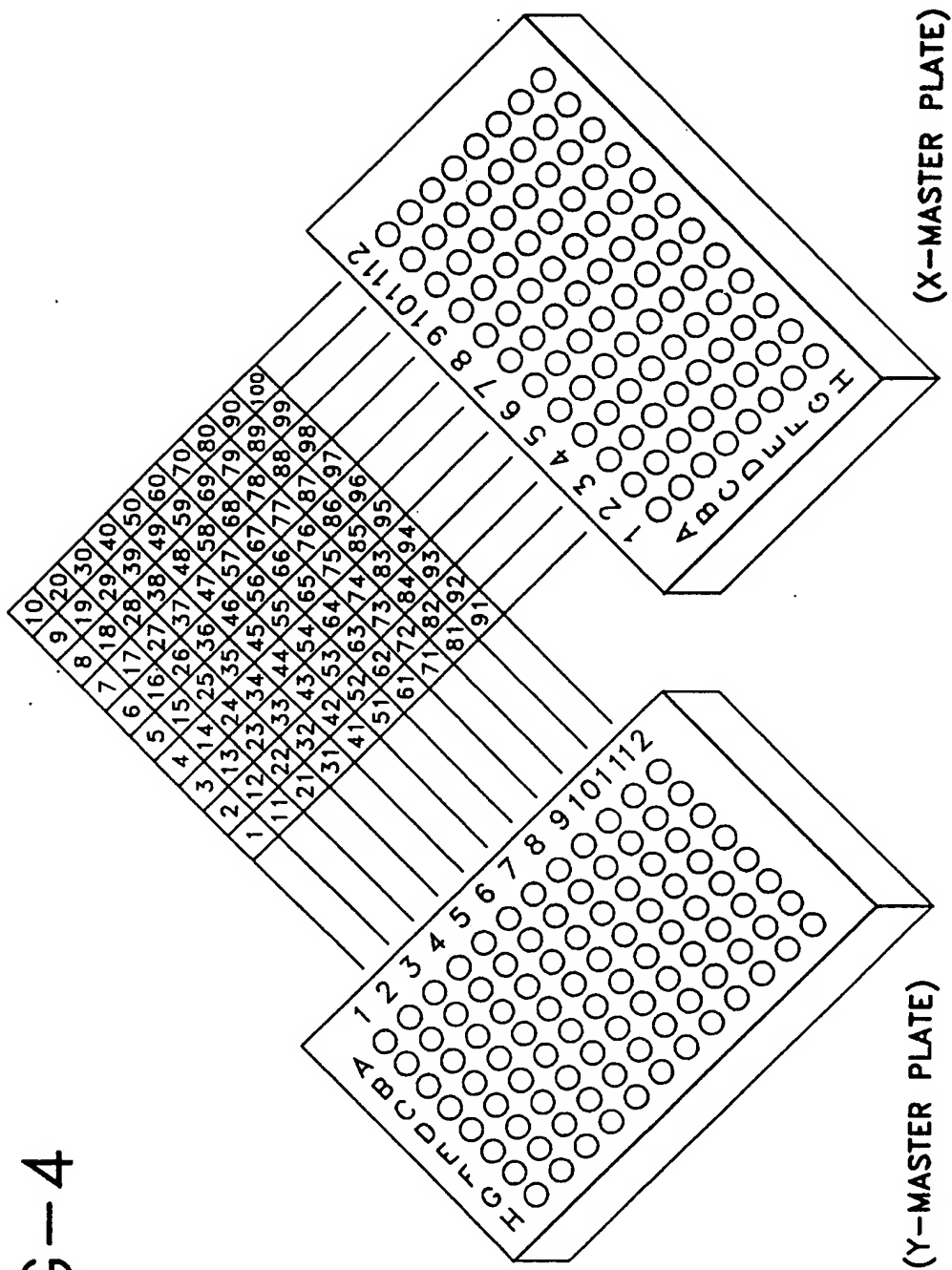
FIG-2



3/5

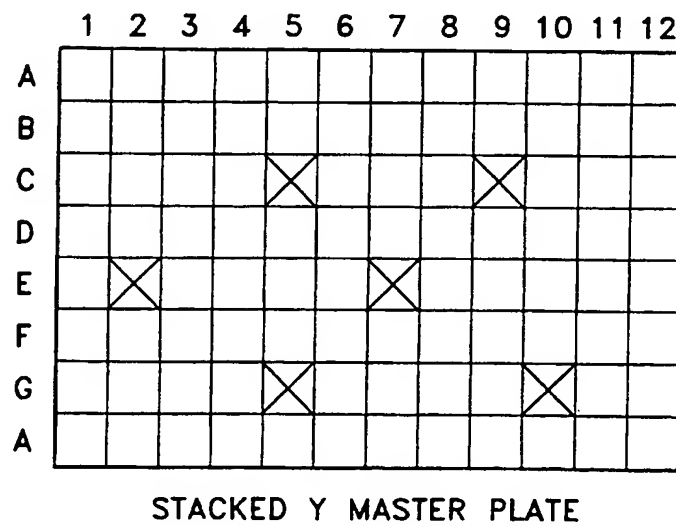
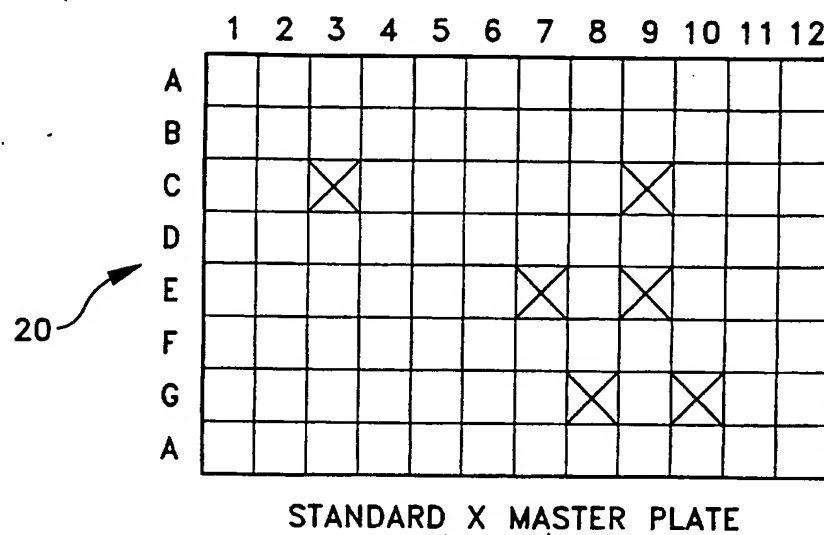


4/5



5/5

FIG-5



INTERNATIONAL SEARCH REPORT

International Application No
PL 1/US 96/01092

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G01N33/53 G01N33/50 C12Q1/00 G01N35/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G01N C12Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 063 810 (CIBA-GEIGY AG) 3 November 1982 see page 3, line 6 - page 4, line 7 see page 18, line 8 - page 23, line 3; figure 1	1-4,34
Y	--- WO,A,93 13423 (THE SALK INSTITUTE FOR BIOTECHNOLOGY / INDUSTRIAL ASSOCIATES INC) 8 July 1993 cited in the application see the whole document --- -/--	1-36

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

7 August 1996

Date of mailing of the international search report

13.08.96

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Van Bohemen, C

INTERNATIONAL SEARCH REPORT

International Application No
PC./US 96/01092

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>JOURNAL OF CLINICAL MICROBIOLOGY, vol. 20, no. 2, 1984, CHICAGO IL USA, pages 255-258, XP000567258 S. DE MARIE ET AL.: "Filter radioimmunoassay, a method for large scale serotyping of Neisseria meningitidis." see page 255, column 2, line 28 - page 256, column 2, line 37 -----</p>	1-36

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 96/01092

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-63810	03-11-82	AR-A- 231590	28-12-84
		AU-B- 560790	16-04-87
		AU-B- 8306982	04-11-82
		CA-A- 1200761	18-02-86
		GB-A,B 2099578	08-12-82
		JP-A- 58009070	19-01-83
		US-A- 5486452	23-01-96

WO-A-9313423	08-07-93	AU-B- 3416893	28-07-93
		CA-A- 2121506	08-07-93
		EP-A- 0617791	05-10-94
		JP-T- 7505710	22-06-95

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

☒ **BLACK BORDERS**

☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**

☐ **FADED TEXT OR DRAWING**

☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**

☐ **SKEWED/SLANTED IMAGES**

☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**

☐ **GRAY SCALE DOCUMENTS**

☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**

☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**

☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.